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## Article

# Strategic performance measurement using balanced scorecard: A case of machine tool industry

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## STRATEGIC PERFORMANCE MEASUREMENT USING BALANCED SCORECARD: A CASE OF MACHINE TOOL INDUSTRY

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**Abstract:** This paper focuses on implementation, monitoring, and application of balanced scorecard (BSC) techniques in an organization involved in providing machine tool solutions to the industrial sector. The growth of the company considered in real time constituted improvements of both top and bottom lines. In the industry under consideration, it was observed that in our company, the top line was steadily growing but not the bottom line. This is when we started getting down to brass tacks and strategically focusing on growth in overall profits of the company. This included growing revenues by improving of EBITDA (earnings before interests, taxes, depreciation, and amortization) and by increasing efficiency (i.e., cutting costs). These improvements were implemented by chalking out a comprehensive BSC designed to suit the machine tool industry. The four perspectives of the management, namely, internal business process, organizational learning, financial perspective, and customer perspective, have been considered lucidly and enunciate the parameters that affect the BSC very aptly. The BSC designed considered 9 objectives and 27 relative measures of these factors to quantify the various quantitative and qualitative dimensions that affect the company's performance. A Balanced Lean Index (BL Score) was used to measure the results for company X.

**Keywords:** balanced lean index, balanced scorecard, internal business process, organizational learning, financial perspective and strategy.

### 1 Introduction

The balanced scorecard BSC is a strategic planning and management system that is used extensively in business and industry, government, and non-profits organizations worldwide to align business activities to the vision and strategy of the organization.

When organizations grow big, there is always a question in the minds of the management as to whether the existing business processes are yielding results or not? Many a time, performance is linked to the turnover of the company, but this is not the only measure of the performance of the company.

The BSC retains financial measurement as a critical summary of managerial and business performance,

but it highlights more general and integrated set of measurements that link four perspectives, namely, current customer, internal process, employee, and system performance, to long-term financial success. Thus basic concepts of BSC are that we should perform on all the four perspectives (Bible, et al., 2006). Thus our focus in our company had been to bring in a score that would consider all four perspectives. The organizational performance was measured as a derivative of the result of activities linked to the business processes with all the four perspectives considered.

Fig. 1 provides a framework to translate a strategy into operational terms.

## The Balanced Scorecard

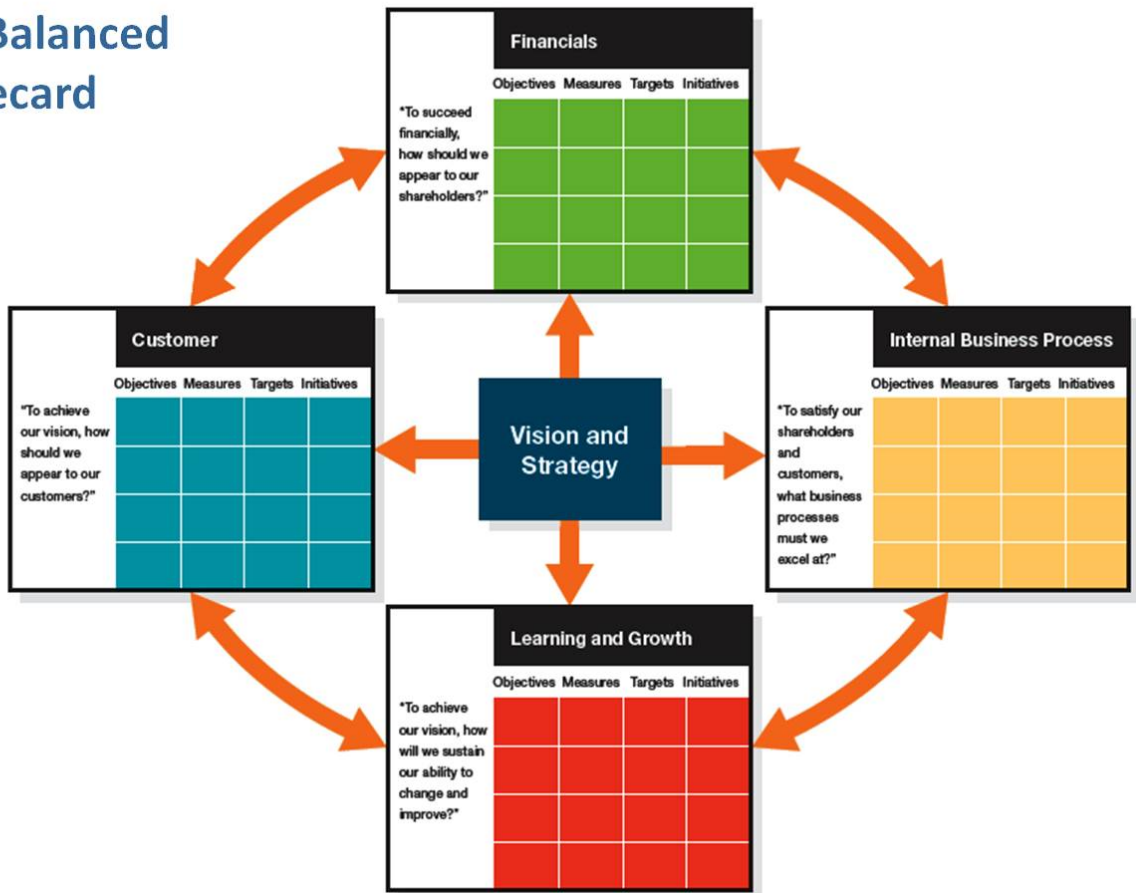


Figure 1. The balanced scorecard  
(source: Kaplan and Norton, 1996)

Following are the objectives of our research:

- to derive a BSC for a company involved in the machine tool business and to monitor this scorecard dynamically on a monthly basis at the organizational level, department level, and individual level,
- to study how the dynamics of real-time monitoring of the BSC helps to enhance company performance,
- study and improve on the business model of the company under consideration based on the dynamic BSC monitoring.

## 2 Literature review

The BSC has come a long way since its initial humble beginnings as a performance measurement tool. It has gone through metamorphic changes regarding its design and implementation over the past 22 years at each stage of its development since Kaplan and

Norton first introduced it in 1992. The BSC has now grown into an effective management tool that directs strategy throughout many organizations globally.

The BSC is a strategic performance measurement system devised after a year-long multi-company research project by Kaplan and Norton (K&N). They, like many other academics at the time, realized that traditional financial performance measures that worked well in the industrial era were out of touch with what companies were trying to achieve today (Kaplan & Norton, 1992). It was no longer tangible assets that create organizational value but intangible assets. They also noted that today's managers realized the impact that measures have on performance but few actually grasped the impact measurement could have on strategy (Kaplan & Norton, 1993). Furthermore, they stressed that no single measure could provide a clear performance target; hence, managers require a balanced presentation of financial and operational measures (Kaplan & Norton, 1992).

Each perspective helped answer a basic performance question: Can we continue to improve and create value? What must we excel at? How do customers see us? How do we look to shareholders? (Kaplan & Norton, 1992). In 1993, K&N used Rockwater, a worldwide leader in underwater engineering and construction to illustrate the BSC in use. Each box contained a small number of measures that related to that perspective. In the case of Rockwater, they had 20 measures with not more than 6 in each box. As you can see, there are some attempts to provide connections between strategy and the measurements (Fig. 3); however, it is widely recognized that these links were weak and forged (Lawrie & Cobbold, 2004).

The original concept, although widely received, was not without flaws (Letza 1996). The underlying notion of the BSC involved placing four to five measures into four boxes as a performance measurement tool. The method used to select these measures (filtering) and which measures should appear in which perspective (clustering) was initially vague (Lawrie & Cobbald, 2004). This was apparent with Rexam Custom Europe (RCE) as they encountered problems limiting the 35 measures first proposed when implementing the scorecard (Letza, 1996).

Furthermore, despite stating that vision and strategy were at the center of the BSC (Kaplan & Norton, 1992), there was little connection offered between how simply placing measures in a box actually linked to an overall strategy. As a result, the design was usually segregated into four perspectives, whereby a group of people would focus on financial measures, a group of people would focus on customer measures, and so on. This led to inconsistent measures and targets (Lawrie, 2011). However, these issues started to be addressed with further publications by K&N in 1996 and 2000. K&N started to revise and improve the BSC as they obtained more experience with it (Bible, Kerr & Zanini, 2006). The 1996 article acted to reduce some of the ambiguity surrounding implementation. It introduced four management processes that contributed to linking long-term strategic objectives with short-term actions (Kaplan & Norton, 1996). The first process, “translating the vision,” helped managers build con-

sensus and clarify the organizations vision and strategy. This enabled “communicating and linking” where managers could communicate long-term strategic goals throughout the organization. The “linking” aspect helps to align employees’ individual performance with the strategy. “Business planning” involves milestone and target setting and aligning strategic incentives with these targets. Finally, “feedback and learning” allowed managers to monitor and evaluate performance in regard to BSC perspectives.

For the most part, four perspectives continued to be used, albeit with greater flexibility and slight variations in name. For example, “Internal Business” later became “Internal Process” perspective. Furthermore, the original finance perspective question posed by Kaplan and Norton (1992) “How do we look to Shareholders?” was significantly flawed as the BSC starting being used in public sector organizations. Lawrie and Cobbold (2004) split the development of the BSC into three generations. First-generation scorecards are those that occur between its foundations in 1992 and precede the follow-up publications by K&N. Second-generation scorecards include these later K&N articles and books that act to address the weaknesses of implementation and causality. Third-generation scorecards are a refinement of second-generation design with new features intended to give better functionality and strategic relevance. This development comes as a result of the BSC move into non-profit and public sector organization in the early 2000s. Non-profit organization without shareholders rendered the financial perspective useless.

A simple choice of “activity” and “outcome” objectives linked with simple causality removes debate about missing perspectives. The only issues now were whether the right activities are represented and whether the correct outcomes from these activities are shown. The activity perspective replaced the “learning and growth” and “internal process” perspectives and outcome perspective replaced the “financial” and “customer” perspectives. Despite these developments, the fundamental principles remained. Combinations of non-financial and financial measures play a huge part in driving strategy.

### 3 Balanced scorecard as a strategic performance management tool in a machine tool industry

Enterprises are considered as the backbone of any economy world over, but they face several challenges today. Treating annual reports to represent health of an organization is no more adequate for the companies that are looking to build world-class excellence. Financial parameters are important to measure past and current effectiveness, but they do not really represent the longevity and sustainability of the results.

Enterprises' prime source of competitive differentiation is exceptional people and business processes they develop. Their cycle of struggle and fire-fighting begins with ineffective business processes and poor emphasis on training process, leading to ineffective results. People can be genuinely inspired if their organization has a compelling vision and

a clear, worthwhile mission, and these can be powerfully expressed in well-crafted mission and vision statements.

A complete internal process value chain that starts with vision, innovation process, identifying current and future customer needs, and developing new solutions for these needs must be defined.

Process that is not measured can never be corrected; hence, perfecting the business process and building a learning culture for continuous improvements need a well-established modeled process such as BSC to deploy vision to individual tactical objective, leading to an environment of desire to deliver and capacity to excel.

For our organization, which was into the machine tool industry, we formulated the vision, framed the strategic goals, and defined the strategic objectives as shown in Fig. 2.



Figure 2. Vision and strategy for the machine tool organization "X"

The strategic objectives of implementing world class manufacturing (WCM) were further divided into subobjectives, as a subset of the four perspectives of BSC. People can be genuinely inspired if their organization has a compelling vision and clear, worthwhile strategic goals. And these can be powerfully expressed in well-defined business model.

Depiction of vision to strategic goals with clear strategic objectives in the form of business model can be highly motivating when they are expressed clearly with strategic intent and communicated effectively to everyone in the organization. They also express your organization's purpose to customers, suppliers,

and shareholders on whom they can have the same effect too. Vision and strategy for the machine tool organization "X" under consideration is illustrated on Fig. 2.

A WCM business model was developed, depicting philosophies, systems, and processes that we implemented for organization to become a WCM company.

#### 4 Business model of organization

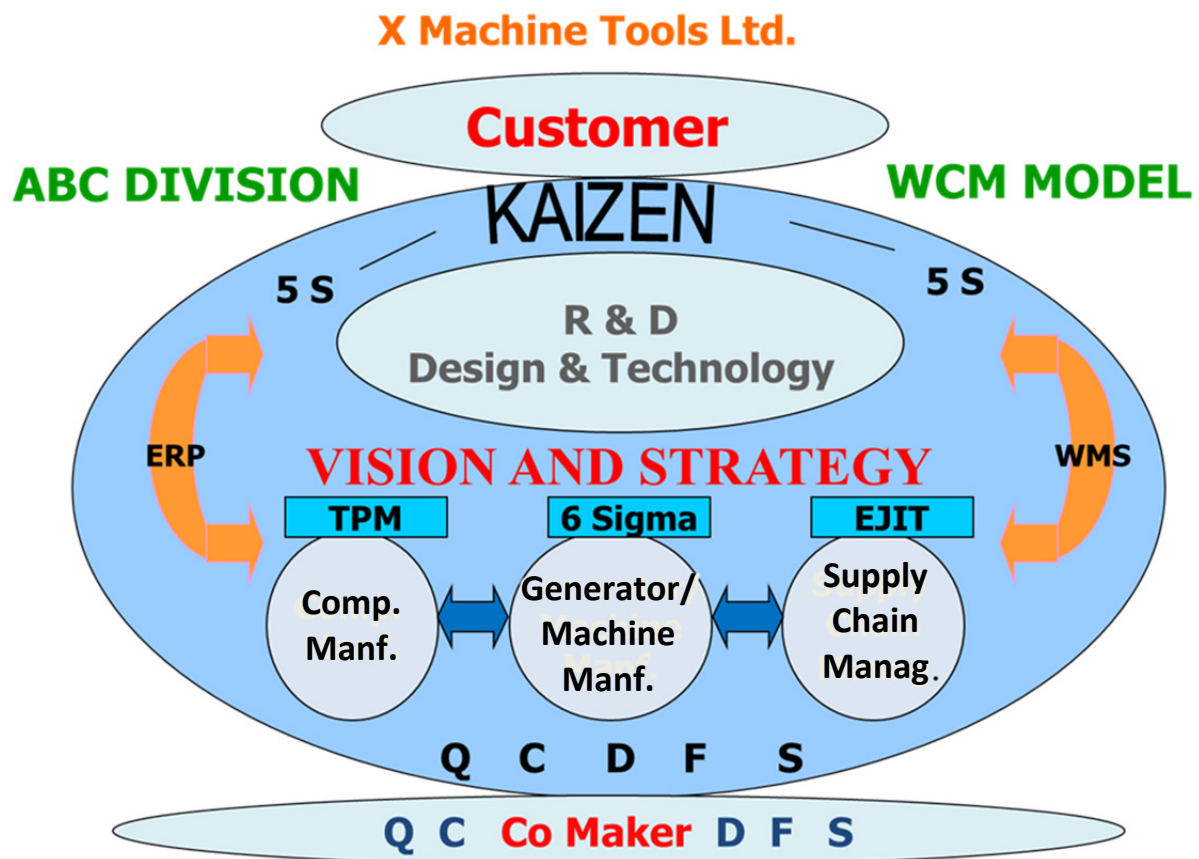


Figure 3. Business model of organization

The following are the definitions of the various philosophies and other work practices that are used to depict the business model:

- 1) 5S – a Japanese philosophy of workplace management;
- 2) KAIZEN – continuous improvement;

- 3) WMS – work management system, an in-house objective-based development;
- 4) TPM – total productive maintenance, a system to make easily maintainable machines to reduce downtime;

- 5) EJIT – an X company-specific effective just-in-time concept suitable to machine tool industry;
- 6) Six Sigma – an internationally known diagnostic and improvement technique;
- 7) Comp. Manf. – components manufacturing, components required to build machines;
- 8) Generator /Machine Manf. – generator/machines manufacturing, electronic panel and machine tool manufacturing;
- 9) Co-maker – vendor supplying material and/or machined component to the organization X;
- 10) ERP – enterprise resource planning (we used SAP R3 in this company);
- 11) QCDFS – quality, cost, delivery, flexibility, and service are the various parameters on which we evaluated our vendors.

## 5 Discussion

“Unless you measure you cannot correct”, but the measurement system should be linked to the peoples’ performances who generate the various factors. There should be an organized mechanism with a very well laid down structure to measure the performance of company at three distinct levels, that is:

- top level – company performance,
- second level – teams, that is, at example strategic business units level,
- third level – individual level.

In our company “X,” we called the BSC measure as balanced lean score (in short, BL score). This BLS had to be a derivative of vision and strategic goals of the company. These goals were deployed through team objectives. We picked up the QCDFS model, which stands for, respectively, quality, cost, delivery, flexibility, and service.

As a first step, we divided the four perspectives at top level into nine objectives at the team level. These were further driven down to 27 measures linked to task-oriented objectives (TOOs) at individual level. The balanced lean indicators for each perspective after a detailed study were given the following marks based on the importance to our organization and our type of industry:

- (A) Internal business processes perspectives – 250 marks,
- (B) Organization learning – 100 marks,
- (C) Financial perspective – 250 marks,
- (D) Customer and co-maker delight – 400 marks.

### (A) Internal business processes perspectives

The internal processes of the organization includes two process objectives, namely, improved lean business processes and improved working capital utilization. Improved lean business process such as Six Sigma, 5S, and XJIT (X-company-specific effective just-in-time (XJIT) methodology developed with machine tool industry requirements in mind). The reason we needed to define XJIT concept is that the normal just-in-time concept is suitable for mass manufacturing environment and not suitable to our type of manufacturing company, which has batch production. The improved working capital utilization objective was measured by focusing on tracking the XJIT inventory and current ratio of the company.

### (B) Organizational learning perspective

This perspective was tracked by building the competency matrix and deriving the training needs of the organization.

### (C) Financial perspective

The objectives of this measurement were to obtain the productivity and profitability of the company as follows:

#### • Productivity

For productivity, we measured the Machine Delivery Index (MDI) achievement and MDI sigma. The MDI sigma signifies the uniformity with which we have delivered the targeted number of machines over a particular month. A minimum MDI sigma also indicated uniform dispatch of machines to customers and, hence, reduced unnecessary stress on other processes in the organization.

#### • Profitability

For profitability, we measured FTR (first-time-right) rating, Product Cost Index, Warranty Cost Index, Overtime (OT) Cost Index, and Facility Management.



#### (D) Customer and co-maker delight

This measure of customer satisfaction was covered by recording the mean time between failures (MTBF) in months and MTBF sigma. All efforts were to reduce the above two measures in order to improve the reliability of the machine, which is basically the improvement in the rate of change of quality. Improving the SPP rating, which is basically site plug and play rating, to ensure that there were no problems and that successful and smooth installation of the machine is taking place at the customer site. Compliance to TPM (total productive maintenance) included basic CLIRT (i.e., clean, lubricate, inspect, retighten) concept that took care to see that even the basic requirements of the customer concerning maintainability are not left unattended. Customer satisfaction was addressed by other important parameters using OTP (on-time product) delivery, OTT (on-time trial) which is on time customer buy off of the machine, customer training to their satisfaction, Warranty Material Delivery Index were all the measures which lead to customer delight.

Co-maker Delight – Here co-makers mean all our key suppliers who were actually thought of as our partners in the mission to achieving WCM goals and their satisfaction and motivation resulted in turn into effectively meeting customer delight objectives. This was measured using the SCR (Supply Chain Rating) by tracking the QCDFS model. On-time payments of dues to the partners lead to co-maker delight and also improved their motivation to work with enthusiasm to meet the company goals. SOS was a measure that captured production line stops measured as SOS per 1,000 MDI points, where MDI is a measure of production output. This helped to remove bottleneck situations for interruption-free production flow. The strategic objectives and tactical objectives were clearly spelt out for all four perspectives of the BSC in Table 1 of Annexure B.

Tactical objectives were deployed by evolving various KPIs (key process indicators) at company level, team (department) level, and individual employee level through an in-house-developed WMS (work management system) as follows: We chose company growth measured by yearly turnover in rupees as a KPI at company level. We chose 27 KPIs to align with the set of 9 tactical objectives in the BSC,

as shown in Table 2 of Annexure B. Each KPI was supported by various teams depending on their designated function. There were 16 teams tabulated on the excel sheet on horizontal axis and KPIs with tactical objectives on vertical axis. The improvement in BL score was achieved by improvement in the system, process, and people objectives. The BL score of each department clearly indicated the areas of improvement we needed to focus. One needed to dynamically monitor the BL score on a monthly basis and define a unified action plans that were implemented all across the organization. This did not depend on the department heads but were well connected to the vision, mission, and goals of the organization. In order that we improved the department's BL score, we needed to set the TOOs for the relevant month at the individual level across the organization to focus and improve on the weak link identified in Tables 2 and 3 of Annexure C.

## 6 Results and Findings

This study is focused on BSC as a tool for strategic performance measurement in the machine tool industry for our company X under review. Following generalized results have been observed hereunder. These results, though specific to company "X" and machine tool industry in particular, throw light upon the role of matrices such as BL score as an effective control measure in medium and large enterprises. It was observed that

- The overall company performance in terms of EBITDA (earnings before interests, taxes, depreciation, and amortization) improved from 13.4% to 15.6%.
- Employee and customer satisfaction showed remarkable improvement. The attrition rate was brought down from 20% to 12.8%. Customer retention improved from 42% to 57%.
- There was a spirit of healthy competition throughout the organization at all departmental levels leading to higher BL score achievement on continuous basis.
- Co-makers' (suppliers and partners) response improved because of the implementation of QCDFS rating, and they were motivated as their payments were made on time.



- Implementation of the critical lean business processes such as Six Sigma, 5S, EJIT, monitoring of EJIT inventory, and current ratio helped to keep the organization in line with WCM practices and critical financial measures.

### Managerial implications

The above findings enable us to draw some key conclusions for company X and machine tool industry as stated in the following text. Some or most of these observations can be used by practicing managers and researchers to evaluate the use of BSC as a strategic performance measurement tool for their company or industry.

- BL score gives a buttressed measure of the business model of an organization depending on the changing environment in order to achieve the vision, mission, and strategic goals of an organization. It serves as a holistic approach to evaluate organizational performance. Specific measures such as financial returns alone give lopsided view of the organization's scope and direction.
- Comparison of the departmental BL score with the organizational BL score for all four perspectives shows that there needs reinforcements in particular measures to be taken up as the TOOs for the forthcoming months at individual levels. This is an effective way to communicate organization's strategy to the lowest level of employee working for the vision of the company. In the absence of such trickle-down departmental approach, the concept of strategy remains elusive to the core people who in fact are assets executing such a strategy for the organization.
- The team leader will focus on his/her department, and his/her actions should support the vision and strategic goals of the company. Thus his/her efforts will be integrated actions to improve the BL score which in turn is linked to the vision of the company. This way the entire organization's performance improves. It is an essential mechanism that takes execution of strategy from people and processes to agenda in boardrooms.

A blanket statement of desirables without appropriate action points can often derail the system. To simplify, consider a company which targets

“20% growth in market share over next 3 years.”

This goal will have little meaning unless smaller packets of signals in the form of customer perspective and financial perspectives are framed and discussed to the sales and marketing teams. BL score using BSC does this internal communication very swiftly without creating too much noise.

- BL scores are two-way control mechanism. They complete the loop of control from top to the bottom and back to the top again. The BSC method of strategic performance measurement is more enduring and, at the same time, flexible enough to accommodate necessary changes for future modifications.

### 7 Limitations and scope for future research

- When we measure the BL score, the checklist or measurement parameters should be exhaustive, but this is not so in our list.
- Some of the qualitative parameters cannot be quantified and may not get the desired attention in the BL score measurement.
- People who make the checklist of BL score measurement should have a complete picture of all the four perspectives, but this is not so in some cases, and this can lead to differential treatment of some of the perspectives.
- It is observed that people become complacent on achievement of around 70% BL score. This is the time when the motivation has to be high and out-of-the-box thinking should prevail to modify the checklist to include factors that really affect BL score.
- The BL score parameters are not unique for all industries, and also the weightage for each parameter differs from industry to industry. This leaves us with a wide variety of scope for future analysis.
- This is a dynamic measurement, and continuous improvement will remain the order of the day.
- The BL score defines the business model that we need to use to improve the performance of the company and is futuristic in thought process.

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## Annexure A

Abbreviations used in this research study:

- 5S – A Japanese philosophy of workplace management
- 6 SIGMA – An internationally known diagnostic and improvement technique
- BLI – Balanced Lean Indicators
- BL Score – Balanced Lean Score
- BSC – Balanced Scorecard
- CLIRT – Clean, Lubricate, Inspect, Retighten
- CM – Competency Matrix
- CR – Current Ratio
- FTR – First Time Right
- JIT – Just in Time
- KAIZEN – Continuous Improvement
- KPI – Key Performance Indicators
- MDI – Machine Delivery Index
- MTBF – Mean Time between Failures in months
- MTBF-Sigma – Mean Time between Failures Sigma
- OTP – On-Time Product
- OTT – On-Time Trial
- POU – Point of Use
- QCDFS Rating – Quality, Cost, Delivery, Flexibility, Service Rating
- SBU – Strategic Business Unit
- SCR – Supply Chain Rating
- SPP Rating – Site Plug and Play Rating
- TOO – Task-Oriented Objectives
- TPM – Total Preventive Maintenance
- TTM – Time to Market
- WMDI – Warranty Material Delivery Index
- EJIT – Effective Just in Time

**Annexure B**

Table 1. Dimensions of balanced scorecard (BSC)

Perspective	Financial	Customer and co-maker	Internal process	Organization learning
Strategic objective	To protect shareholder's interest leading to growth and profits	To meet and exceed customer expectation leading to customer delight and integrate co-maker care	To implement continuous improvements leading to operational excellence	To create employee participation leading to employee capability
Tactical objectives	1. Improve productivity to deliver new products for growth 2. Improve profitability to bring market sustenance at affordable cost	1. Improve customer satisfaction, retention, and loyalty 2. Improve image and reputation by offering product technology and service aligned to customer preference	Improve LEAN business processes to deliver value to customer Improve working capital utilization to improve cost of existing process	Improve competency matrix to nourish employee capabilities Training of employees to motivate, empower, and align to vision

KPIs aligned to tactical objective of BSC.

Table 2A. Financial perspective

Strategic objective ⇒ To protect shareholder's interest leading to growth and profits

Tactical objective	KPIs	Definitions of KPI
1. Improve productivity to deliver new products for growth	1. MDI	Machine delivery index: it is a number derived based on product selling price and product material cost. It is published for all products and known to ALL at the beginning of the year.
	2. MDI sigma	It is a measure of uniform dispatches throughout the month and important to maintain uniform cash flow
	3. TTM	Time to market: it is a measure of time taken to introduce the product to the customer from the time it is conceptualized. It shows effectiveness of a company to deliver in time and to face competition, thereby plays a vital role for the growth of company, viz, turnover.
2. Improve profitability to bring market sustenance at affordable cost	1. FTR rating	First time right: it is a measure of rejection at all stages of value chain.
	2. Product Cost Index	It is measure of product cost that is vital to decide contribution value of each product model. It directly affects profitability.
	3. Warranty Cost Index	It is a measure of product performance and cost involved in providing warranty service to customer.
	4. OT Index	Overtime index: it is a direct measure of manufacturing cost incurred.
	5. Facility management	It is a measure of how effectively tools and tackles and support system are maintained to smoothly carry out manufacturing without stops.

Table 2B. Customer and co-maker perspective

Strategic objective ⇒ To meet and exceed customer expectation leading to customer delight and integrate co-maker care

Tactical objective	KPIs	Definition Of KPI
1. Improve customer satisfaction, retention, and loyalty	1. MTBF	Mean time between failures: it is a measure of product performance and reliability of product performance. It directly affects customer retention and loyalty.
	2. MTBF sigma	It shows the uniform product performance at all customers' sites.
	3. SPP rating	Site plug and play: it is a measure of problems during commissioning of product at site. It has direct bearing on customer dissatisfaction.
2. Improve image and reputation by offering product technology and service aligned to customer preference	1. On-time delivery	It is a measure of delivery commitment versus actual. It is very important for image and reputation.
	2. On-time trial	Customer trials of machine capability before customer buys the product. It is very important for image.
	3. Customer training	It relates to proper training before it starts using the machine This rating is by customer against various aspect of training imparted by trainer, essentially a company employee.
	4. Warranty Material Delivery Index	It tracks the delay in delivery of material to customer during warranty, to reduce downtime at the customer site.
3. Improve quality of supply from co-maker	1. Supply chain rating * SOS/1000MDI	It is a measure of supply chain supplying on time and quality material to manufacturing line.
	2. On-time payment * Delay days	It is a measure of delay in payment to supplier, a very important aspect of customer care.

Table 2C. Internal growth perspective

Strategic objective ⇒ To implement continuous improvements leading to operational excellence

Tactical objective	KPIs	Definition of KPI
1. Improve lean business processes to deliver value to customer	Implementation of systems and processes such as:	It is a measure of effectiveness of new processes such as:
	1. Six Sigma	Six sigma for problem solution.
	2. 5S	5S for workplace management.
	3. EJIT	EJIT for product delivery in time and at defined manufacturing cost
2. Improve working capital utilization to improve cost of existing process	1. EJIT Inventory	It is a measure of inventory of raw material, work in progress, and finished goods under JIT system.
	2. Current ratio	It is a very well known measure of liability and asset at any time.

Table 2D. Organization learning perspective

Strategic objective  $\Rightarrow$  To create employee participation leading to employee capability

Tactical objective	KPIs	Definition of KPI
1. Improve competency matrix to nourish employee capabilities	Competency matrix	It is a measure of competency available versus what is required in the future for the organization. It is measured and targeted in numbers.
2. Training of employees to motivate, empower, and align to vision	Training hours	It is a measure of total number of training hours imparted to employees on various skill set, soft skill, and others.